KEASBEY & MATTISON COMPANY

MANUFACTURERS OF ASBESTOS AND MAGNESIA PRODUCTS SINCE 1873

AMBLER, PENNSYLVANIA

EXECUTIVE OFFICES

January 18, 1940

K&M No. 1722

W. W. F. Shepherd, Esq.
Turner & Newall Ltd.
Spotland, Rochdale

Dear Mr. Shepherd:

During the course of the past three years the Keasbey & Mattison Company, along with most of the other firms in the asbestos industry in the U.S.A., have been financing research work on asbestosis carried out at the Saranac Laboratory by Dr. Leroy U. Gardner, and in order that T.& N. may also have the benefits of the work which is being done, I have pleasure in handing you herewith photostat copies of Dr. Gardner's recent report and the photographs relating thereto.

I am also sending copies of these to Mr. O. C. Smith at Thetford Mines.

Yours sincerely,

KEASBEY & MATTISON COMPANY

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Att.

PLAINTIFF'S EXHIBIT WV-000373 tabbies

PLAINTIFF'S EXHIBIT 01198.00 tabbies

Mr. Shepherd

Interim Report on Experimental Asbestosis at the Saranac Laboratory

MANUSCRIPT. Left for Baltimore.

The original purpose of these experiments was to reproduce in animals an advanced stage of asbestosis whose progress could be followed anatomically and in x-ray films. There were two major objectives - one, to establish a better correlation between the various shadows seen in x-rays and the pathological changes in the lungs, and the other to determine in how far associated infection was responsible for the severer manifestations of the disease.

Upon the basis of previous experience with pure free silica, it was thought that the reaction to inhaled asbestos would develop most rapidly if the inhaled fibres were exceedingly fine. Accordingly Canadian chrysotile was ground in a steel ball mill until practically all of the material was reduced to 2 microns or less in maximum diameter.

This ground fibre was placed in a hopper and churned to liberate dust in the atmosphere of an 8x8x8 foot animal room. It has not been previously reported to the sponsors of the experiments and in fact the writer was until recently unaware that one volume of unground fibre was being added to every three volumes of the very fine asbestos to facilitate agitation of the material in the hopper. Thus there has been a limited amount of long fibre asbestos liberated in the atmosphere, however the quantity is comparatively small as the paddle, moving freely in the hopper, does not fracture much of the coarse fibre. The average concentration of fine asbestos dust inside the animal cages ranged about the wall of this room has been 145 million particles per cubic foot of air. (It should be noted that this figure is 29 times that set by the U.S.Public Health Service as the maximal permissable concentration of asbestos dust in industry).

Exposed to this concentration for 8 hours a day, 6 days a week, were 80 guinea pigs, 8 rabbits, 20 white rats and 17 cats. Beginning with the fifth month of the exposure, sample guinea pigs were sacrificed at intervals. The last group was killed on Sept. 25,1939, thirty months after starting the exposure. As shown in figure 1, there is barely enough change in a thin microscopic section to be visible on magnification of 2 or 3 diameters. Still higher magnifications (not reproduced here) reveal that the reaction is not fibrous in character, but more of the nature of a chronic inflammation.

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Figures 2A and 3A show the less advanced changes after exposures of 12 and 20 months respectively. Figure 2B demonstrates for comparison the very much greater reaction obtained after a 12 months asbestos exposure in a previously reported experiment. In that instance the average atmospheric dust concentration was only about one-third that in the present experiment, but the fibre was longer in that case.

This experience seemed to demonstrate that, contrary to the behavior of quartz, asbestos dust would not become more irritating as the size of the particles decreased.

This conclusion could not be maintained, however, until it was proved that the particular lot of asbestos was capable of producing fibrosis in the lungs of guinea pigs. The only way to be certain of this point was to try another inhalation experiment as previous experience had shown that injection tests are not applicable to asbestos dust as they are with quartz.

Accordingly, in the fall of 1938 another dust room was taken over for an experiment with unground asbestos of the same lot. After some experimentation a suitable dust, containing a high proportion of fairly long fibres was secured by affixing both to the sides of the dust hopper and to the rotating paddles a series of steel wire brushes. The shearing action of the opposing sets of wires broke the asbestos into lengths that could be inhaled. Inside the cages the average atmospheric concentration of fibres that could be expected to be inhaled into the lungs was 37.5 million particles per cubic foot of air.

On the same 8 hour daily schedule 100 guinea pigs, 20 white mice and 6 cats were exposed in this room.

The guinea pigs have been sacrificed at intervals, the last group being killed on November 3, 1939, one year after starting the exposures. As shown in figure 3B there is much more reaction to the long fibres than to the finely ground material from the same lot, even though the concentration in the air was only about one-fourth as great. Higher magnifications show that the longer fibres are beginning to cause fibrosis rather than the chronic inflammation produced by the fine material.

To learn more than could be inferred from mere inspection of microscopic sections about the quantities of dust inhaled into the lungs, representative proportions have been subjected to chemical analysis. For the fine material these tests were not started until the 18th month of exposure, when it came to be appreciated that the anticipated fibrosis was not developing. In the long fibre experiment they were made earlier but only a few of them will be reported here as they have no basis of comparison. In the following figures it will be noted

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that in neither series is the weight of inhaled material sufficient to affect the per cent of ash very much.

Magnesium silicate cannot, of course, be determined as such and the amount of available tissue in each lung precluded determination of both magnesium and silica. Therefore only the latter was done. It is to be understood that in the table the SiO_2 values are merely an index of the relative amounts of asbestos present in the different lungs. The values shown by the figures for 1 month's exposure to long fibre asbestos begin to approximate those for a normal guinea pig. It will be noted that 3 or in some cases 2 animals' lungs were analysed after each interval of exposure. The results for each is given to indicate the degree of individual variation.

Table

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Period Exposed	Long Fibre Asbestos			Short Fibre Asbestos		
	Dry Lung Tissue		Ash	Dry Lung Tissue		Ash
	% Ash	% SiO_2	% SiO_2	% Ash	% SiO_2	% S
1 mo.	4.35	0.04	1.10			
	4.33	0.09	2.11			
	4.37	0.04	0.93			
8 mo.	4.72	0.10	2.21			
	4.92	0.09	1.90			
	4.34	0.07	1.58			
12 mo.	4.87	0.25	5.20	5.02	0.51	10
	5.02	0.20	4.09	4.58	0.46	10
	5.16	0.31	5.99	5.16	0.54	10
15 mo.				5.00	0.49	9
				4.76	0.43	9.
				4.95	0.53	10.
20 mo.				5.86	0.85	14.
				6.34	0.90	14.
4 mo.				5.42	0.78	14.
				5.50	0.78	14.
30 mo.				5.35	0.96	17.
				6.55	1.27	19.

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The above figures prove that with both long and short fibre dusts significant quantities are entering the lungs. The comparisons at the 12 monthinterval indicate that more short fibre enters the lung than long. This of course would be expected in view of the more ready penetration of the fine dust and the fact that its average concentration in the air was four times as great.

The proof now seems conclusive that grinding asbestos to this degree of fineness destroys its capacity to irritate the lungs.

1. It has been shown that long fibre asbestos will produce significant changes in guinea pigs lungs within a period of one year.

2. It has been shown that on grinding some of the same lot of asbestos it is no longer capable of causing the same effect in 30 months.

3. It has been proved by chemical analysis that the failure to react is not due to failure of the fine material to penetrate into the lungs.

4. It has been shown that about one-fourth the atmospheric concentration of long asbestos fibres has much greater effect upon the lungs than a concentration 145 million per cubic foot of exceedingly fine particles.

This evidence strongly suggests that the irritation from asbestos is not chemical but mechanical in nature. Attempts to prove this hypothesis have taken various directions.

It has been shown in a series of injection experiments that no fibrosis results when asbestos is injected into other organs of the body than the lungs. Chemically active quartz, however, causes fibrosis wherever it comes in contact with connective tissue cells.

It has been shown that, in animals, asbestosis does not progress after cessation of exposure. The reverse is true in the case of chemically active quartz. The smooth covering deposited upon the surface of an asbestos fibre that forms the asbestosis body after two months contact with the tissues would tend to minimize mechanical injury.

It seemed probable that the lungs rather than the other organs should be mechanically injured by asbestos because the lungs move rapidly and constantly. To test this theory the lungs of four dogs were injected with a heavy suspension of long fibre asbestos. By means of a tube in the wind pipe, material was carefully introduced in both lungs. Then one lung was collapsed by

cauterizing the inside of its stem bronchus with silver nitrate so that it no longer moved in respiration. Thus we had what was thought to be effective doses of asbestos in either lung but only one would move to produce the mechanical injury and resultant fibrosis.

The animals survived their treatment with no apparent ill effect. A month ago two of the dogs were killed on the first anniversary of their injection. In each case one lung was well collapsed and there were asbestos fibres on each side. However, there was neither fibrosis nor asbestosis bodies in either lung of both animals. Apparently we were misled by a report in the literature that dogs were susceptible to the action of asbestos. The result was disappointing but the method of attack seems reasonable if it can be applied in guinea pigs. We are now trying to overcome the technical difficulties involved in working with such a small animal.

The matter of species susceptibility is a puzzling feature which need not be discussed here. None of the rats, rabbits or cats exposed to the short fibre asbestos have reacted. The 6 cats, now exposed to long fibre dust for 13 months, are being kept in the dust room until their exposure reaches two years before comparative x-ray and anatomic studies are begun. The guinea pig continues to be a reliable animal with which to experiment.

While the experiments have demonstrated that it is not possible to accelerate the rate of reaction in the body, and the anticipated results have not been realized, it is felt that the effort has been extremely profitable. As pointed out in a previous report to the sponsors, they have shown the innocuousness of finely ground asbestos, which is of real practical significance. They probably explain the lack of asbestosis in the mills at Thetford. They may help to define the hazard in other plants where very finely ground material rather than fibres constitute the major element in the dust. They serve as a guide to engineers who must control the hazard in plants, indicating that their efforts must be directed particularly toward the fibrous material in the air.

In view of the probability of fulfilling the original purpose of these experiments, it is hoped that the sponsors may agree to renew their appropriation for another year. For the past 12 months the Laboratory has assumed the obligation of operating a second dust room for the asbestosis work. The expense is somewhat over $5000. In addition it has carried on various collateral injection experiments, such as those upon the dogs and others not mentioned in this report. It has secured an appropriation for an inhalation experiment upon the

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the effect of glass wool, which may prove a useful control to the mechanical theory of the action of asbestos. It is hoped that you may find these accomplishments sufficiently valuable to be willing to continue the work.

Respectfully submitted,

Leroy U. Gardner

Leroy U. Gardner, M.D.

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